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EXAMINER

CHEN, KIN CHAN

ART UNIT PAPER NUMBER

1765

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Please find below and/or attached an Office communication concerning this application or proceeding.



**DETAILED ACTION**

***Claim Rejections - 35 USC § 112***

1. Claim 7 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In claim 7, "the first chemistry further includes the first chemistry" is indefinite. It is unclear as to the scope of the limitation.

***Claim Rejections - 35 USC § 103***

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Grimbergen et al. (US 6,081,334; hereinafter "Grimbergen") in view of Witek et al. (US 5,627,395; hereinafter "Witek").

In a process of forming a semiconductor device, Grimbergen teaches that a least one device layer (e.g., polysilicon) and an anti-reflective coating may be formed over a wafer surface. A hard mask may be provided over a portion of the device (col. 5, lines 51-67, Figs. 1a and 1b). A plasma-etch may be applied using first and second etching

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chemistries and selectively etching into the device layer to form a pillar structure (such as gate electrode) having at least one sidewall. The first chemistry may include  $\text{HBr}$ ,  $\text{Cl}_2$ ,  $\text{He-O}_2$ . After using the first chemistry, a plasma-etch using a second chemistry may be performed. The halogen content of the etchant gas may be reduced to obtain slower and more controllable etch rates (col. 18, lines 15-30) in order to stop the etching process without etching through the silicon dioxide underlayer on the substrate (col. 18, lines 15-17).

Unlike the claimed invention, Grimbergen does not teach using nitrogen, rather, Grimbergen teaches using Helium (He) in the second etching chemistry. Grimbergen teaches, after using the first chemistry, using a plasma-etch of a second chemistry that the halogen content of the etchant gas may be reduced to obtain slower and more controllable etch rates in order to stop the etching process without etching through the silicon dioxide underlayer on the substrate. In a method of polysilicon etching, Witek teaches that  $\text{HBr}$  and  $\text{Cl}_2$  are generally used and the inert gas such as Ar, He, or nitrogen may be used. <sup>(col. 5, lines 25-32)</sup> It would have been obvious to one with ordinary skill in the art to use nitrogen of Witek in Grimbergen process because Witek teaches the equivalence between using He and nitrogen in the processes that are similar to those as taught by Grimbergen wherein polysilicon is etched. The substitution of one for the other would have been expected to provide the same function and effect of a non-reactive (inert) gas in the etching process and help provide slower etch rates in the second-stage etching. Furthermore, it is notoriously well known that in the dry etching process, the

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inert gas is used for diluting the etchant and change the etching rate (also see Wang et al. (US 6,232,184) in the record as evidence).

The limitations of dependent claims 4, 9-11, 14, 20, and 21 have been addressed above and rejected for the same reasons, *supra*.

The instant claims differ from Grimbergen and Witek by specifying various nitrogen amount (percent) in the second chemistry (such as claims 1, 3, 5, 7, 8, 15-18). However, a skilled artisan understands that in a plasma etching, the reactive gas content in the etchant gas may be diluted using inert gas in order to obtain slower and more controllable etch rates. Therefore, it would have been obvious to one with ordinary skill in the art to use suitable amount of nitrogen in the process of Grimbergen and Witek in order to obtain slower and more controllable etch rates and stop the etching process without etching through the silicon dioxide underlayer on the substrate.

As to dependent claims 7, 13, and 19, Grimbergen teaches that the first chemistry includes a selectivity booster (such as He-O<sub>2</sub>), see col. 18, lines 22-23.

The above cited claims differ from the prior art by specifying well-known features (such as SiON hardmask in claim 12) to the art of semiconductor device fabrication. A person having ordinary skill in the art would have found it obvious to modify Grimbergen and Witek by using any of same well-known features to same in order to provide their art recognized advantages and produce an expected result.

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**Conclusion**

4. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Wang et al. (US 6,232,184; col. 3, lines 35-38) teaches that the inert gas may be used for diluting the etchant.

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kin-Chan Chen whose telephone number is (703) 305-0222. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin Utech can be reached on (703) 308-3836. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9310 for regular communications and (703) 872-9311 for After Final communications. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-2934.



Kin-Chan Chen  
PRIMARY EXAMINER  
ART UNIT 1765

May 23, 2003